Minutes of ARTIST2 Timing Analysis Meeting on 13 March 2008

Time: 14.00 - 17.00
Venue: Ludwig-Maximilians-Universität München
Lehr- und Forschungseinheit für Programmierung und Softwaretechnik
Oettingenstr. 67
D-80538 München

Attendees: Björn Lisper[1], Reinhard Wilhelm, Christian Ferdinand, Niklas Holsti, Raimund Kirner, Peter Puschner, Iain Bate, Rathijit Sen[2]

Presentation by Björn on items 1 through 5 below.

1 Review meeting

- The reviewers had not made any comments in previous meeting.
- Christian reminded that the reviewers had explicitly mentioned that the work done was of very good quality.
- Final review meeting to be held on December 12.

2 Summer School

- This will be organised from September 8-12
- There has been a 1 month extension to ARTIST2. Payments to be made no later than August.

3 1st workshop on mapping of Applications to MPSoCs

- This is to be held on June 16-17 at St. Goar, Germany.
- Registration is to be done before end of March. Form to be sent to Peter Marwedel.
- Björn to talk to Peter Marwedel to get a dedicated time slot for ARTIST2 TA discussions.

4 Promises for Y4

- Iain pointed out difference in wording: 'continue' and 'finalize'.
- ALF: Brief status report by Björn
  - The work done so far has been slower than expected. Design is mostly in place, but minor details need to be worked out. It is harder to embed ALF in AIR (computation semantics). The implementation may not be finished by September. It is difficult to do this within ARTIST2 timeframes. Probably it will be done within the ALL-TIMES project.
- Flow Description Format: Brief status report by Raimund
  - A presentation was made 2 years ago. The work was funded by some other project. The concepts have been discussed and we have some important results. We need to have more discussions. It is not possible to finish the work within ARTIST2 timeframes. Research in this front needs to be continued.

[1] Chaired meeting
[2] recorded minutes

  - Flow Description Challenge needs to be set up.

- WCET Tool Challenge 2008: Under control
- Timing Predictability: Under control
- Measurement based Timing Analysis: Project started last year. The work is expected to finish later than ARTIST2. Under control.
- WCET-Aware Compilation: There have been new publications. Under control.

5 Year 4 milestone: 'Version 2 integration of existing components'

- There was some confusion about 'version 2'.
- Indicators for Integration:
  - Working integration of Mälardalen's flow analysis with aiT and Bound-T: Some students are working on this, but progress has been too slow.
  - Path description attributes for AIR: Under control
  - Successful embedding of ALF in AIR: Shaky
  - Joint publications about Timing Analysis:
    * Reinhard expressed concern about the long time (one and half years) taken by ACM in publishing the survey results submitted earlier. In contrast, Real Time Systems journal needs 3 months for acceptance and 2 weeks for the final version, after which the work is available online.
    * To think about publishing all activities done jointly
    * Publications in workshops count.
    * To think about publishing the ALF work.

6 WCET Tool Challenge 2008

Presentation by Niklas.

- 7 tools participating.
- SWEET may participate if some benchmarks are available only for flow analysis.
- aiT may participate in combination with SWEET (information such as loop bounds provided by aiT):
  - some students are working on integrating CRL2 with Mälardalen's tools, but progress has been very slow.
  - Björn to look into speeding up this activity.
- New benchmarks:
  - Niklas has some benchmarks which can be distributed only within the WCET-estimation user community.
  - 5 new testcases obtained from Saarland University (created by Rathijit).
  - New benchmarks can be obtained from Mälardalen, Vienna.
  - Raimund to get some benchmarks that are used for MTIME. These are medium-sized benchmarks, not large ones.
  - Powerbench may not be used as they do not correspond to real time applications.
  - It would be very interesting to have Papabench. Christian suggested that compilation for some targets like PowerPC may be challenging.

- It would be interesting to compare flow analysis information generated by WCET tools like aiT with that generated by other flow analysis tools (such as tools from Mälardalen)
- Input data needed by RapiTime:
  - One option could be to use benchmarks with no constraints on input data
  - Another option could be to give input data generated by MTIME
  - Niklas suggested that one of the aims of the Challenge was to get more people to participate. The intent is not to see who is the winner. If we want RapiTime to participate, we need to provide input data along with the benchmark.
  - It could be interesting to compare between WCET results obtained with the input data generated by MTIME and that obtained with the input data provided with the benchmark. This could add value to the evaluation.
- Intrusiveness of analysers:
  - The evaluation should make a clear distinction between intrusive and non-intrusive analysers.
  - RapiTime can also analyse non-intrusively. We want to see which type of analysis they use.
- Compiler:
  - gcc could be used as a common compiler
  - some versions of gcc use some peculiar loop optimization features. Some loops with unknown bounds are unrolled as the bounds check happens every iteration and this destroys the relation with source code. An interesting question in this case is how flow information from source is used by the analysers. We need to fix compiler optimization levels: O2 and above may be more challenging.
  - It could be interesting to compare between WCET results for the following codes:
    * Optimized Code (with loop unrolls) generated by the compiler from the unmodified source
    * Unoptimized code generated by the compiler from the modified source where loops have been unrolled
    * The source-to-source transformation above could be generated automatically.
    * Overall, we need to limit the number of experiments. So not all of the above ideas may be tried out this time. Maybe some could be tried out in future Challenges.
- Iain asked that in the last Challenge, there was 1 person travelling around and carrying out the evaluations. What about this year?
- Christian asked whether benchmarks have function pointers as this considerably complicates the analysis. The majority of the benchmarks have no function pointers.
- Target:
  - Has no cache, but cache like flash buffers which are 128 bit wide and filled end to end.
  - A reference to the user manual for the common target would be made available online.
- Björn suggested that in future we can utilize resources from this activity for more research. We could also add more targets.

7 WCET Annotation Language

Presentation by Raimund. A 10-page Technical Report on *Essential Ingredients for a WCET Annotation Language* was circulated.

- Discussion on Figure 2. Niklas suggested to clarify concept of overrules, interaction of program and environment.
- Niklas suggested to include annotations for writes to 'volatile' variables.

8 ALL-TIMES project

Presentation by Björn.

- Discussion on how it can provide solutions for Timing analysis/estimation for early design space exploration.
  - Iain suggested that many organizations have their own tool flows with which they estimate. The estimates may be 5-10% off, but overall they work quite well.
  - Christian suggested that the above could work for organizations with a fixed product line, but not for others. There are lots of opportunities for WCET analysers in the Automotive industry where there is a need to get good estimates before ordering components.

9 PREDATOR project

Presentation by Reinhard.

- The project aims to reconcile Predictability and Efficiency.
- Project kick-off has happened last week.
- The notion of what is predictability is still open:
  - The idea of tying 'variance' to predictability may not be sufficient.
  - If the analyser is able to analyse accurately, it does not matter if the variance is large or not.
  - Parametric WCET estimates could imply a large variance, yet be 'predictable'.
- Iain to send a literature survey on predictability to Reinhard in a week.

10 MERASA project

Presentation by Björn.

- Acronym for Multicore Execution of hard Real time Applications Supporting Analysability.
- 3 phases: Design Space Exploration, Architecture Refinement, FPGA Prototyping and Pilot Study.

11 Next Meeting

- Date is not yet fixed.
- WCET workshop is on 1st of July (Tuesday). We could have the meeting on Monday afternoon or Wednesday morning.

12 Action Items

- Björn to talk to Peter Marwedel to get a dedicated time slot, within the workshop on mapping of Applications to MPSoCs, for ARTIST2 TA discussions.
- Björn to speed up activity of integrating CRL2 with Mälardalen's tools. This integration is being done by some students.
- Raimund to get medium-sized MTIME benchmarks for the WCET Tool Challenge.
- A reference to the common target for the WCET Tool Challenge to be made available online.
- Iain to send a literature survey on predictability to Reinhard in a week.
- Presentations and meeting minutes to be made available online.